





187-11-13

*Royal College of Surgeons
from the Author*

ON

CANADIAN CAVERNS,

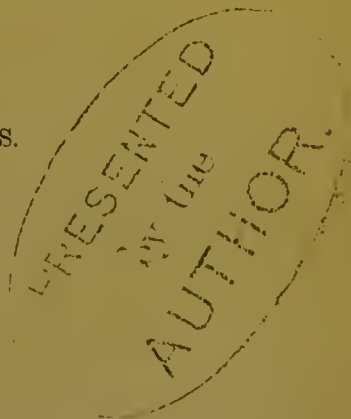
*[Read before the British Association for the Advancement of Science, at
Aberdeen, 16th Sept. 1859.]*

BY

GEORGE D. GIBB, M.D., M.A., F.G.S.,

MEMBER OF THE ROYAL COLLEGE OF PHYSICIANS OF ENGLAND; MEMBER OF THE
CANADIAN INSTITUTE; HONORARY MEMBER OF THE LITERARY AND PHILOSOPHICAL
SOCIETY OF ST. ANDREW'S; CORRESPONDING MEMBER OF THE NATURAL
HISTORY SOCIETIES OF MONTREAL AND OF BOSTON; AND OF THE LITERARY
AND HISTORICAL SOCIETY OF QUEBEC; AND MEMBER OF THE
BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

WITH EIGHT PLATES.



LONDON:

"THE GEOLOGIST" OFFICE,

—
1861.

PRINTED AT THE "GEOLOGIST" OFFICE, 22, SOUTHAMPTON-STREET, STRAND, LONDON.

RESPECTFULLY DEDICATED
TO THE
CANADIAN INSTITUTE.

ON

CANADIAN CAVERNS.

THE prominent feature of a large portion of the province of Canada is the presence of various limestone rocks belonging to the Silurian formations. Until lately, the existence of caverns in these rocks, as well as in those lying subjacent—namely, the Laurentian of Sir William Logan, was almost unknown; as, with the exception of an isolated account here and there, no regular description of any cavern had appeared. Owing to the labours of the Canadian Geological Survey, and of several private individuals, a number of caverns have been discovered at distances remote from one another; some of these have received but a passing notice in the publications of the Survey, and are not, therefore, useful as a means of reference. The present communication, it is hoped, will supply that deficiency, as in it I purpose to embody short descriptive accounts of all the caverns of Canada which are known up to the present time. The details of some of them are not so full as could be desired; nevertheless, with all the available sources of information within my reach, together with personal observation in some, on the whole the general descriptions may be relied upon as accurate, and as containing a correct account of the geological formations in which they lie.

For convenience of description, it may be here stated that the boundaries of the province of Canada are at the present time as follows:—North by the Hudson Bay Company's territories, and shores of James' Bay; on the west by Lakes Huron, Superior, Lake of the Woods, Winnipeg, and Red River; South by Lakes Erie and Ontario, and the states of New York, Vermont, and New Hampshire; and to the eastward by the River and Gulf of St. Lawrence, the state of Maine, the province of New Brunswick, and the eastern coast of Labrador; the whole extending between the latitude of forty-two degrees and fifty-five degrees north, and longitude fifty-six and ninety-eight west.

The caverns of Canada may conveniently be divided into two classes; the first comprises those which are at the present time washed by the waters of lakes, seas, and rivers, including arched.

perforated, flower-pot, and pillared rocks, which have at one time formed the boundaries or walls of caverns, and all of them unquestionably the result of aqueous action. The second comprises caverns and subterranean passages which are situated on dry land, and so far as we know, not attributable to the same causes in their origin as the first, or at least not applied in the same manner.

In the first class are included the following:—

1. Caverns on the shores of the Magdalen Islands.
2. Caverns and arched rocks at Percé, Gaspe.
3. Gothic arched recesses, Gaspe Bay.
4. The "Old Woman," or flower-pot rock, at Cape Gaspe.
5. Little River Caverns, Bay of Chaleur.
6. Arched and flower-pot rocks of the Mingan Islands.
7. Pillar sandstones, north coast of Gaspe.
8. Niagara Caverns.
9. Flower Pot Island, Lake Huron.
10. Perforations and caverns of Michilimacinae, L. Huron.
11. The Pictured Rocks, Lake Superior.
12. St. Ignatius Caverns, Lake Superior.
13. Pilasters of Mammelles, Lake Superior.
14. Thunder Mountain and Paté Island Pilasters, L. Superior.

In the second class are:—

15. The Steinhauer Cavern, Labrador.
16. The basaltic caverns of Henley Island.
17. Empty basaltic dykes of Mecatina.
18. Bigsby's Cavern, Murray Bay.
19. Bouchette's Cavern, Kildare.
20. Gibb's Cavern, Montreal.
21. Probable Caverns at Chatham, on the Ottawa.
22. Colquhouns Cavern, Lanark,
23. Quartz Cavern, Leeds.
24. Probable caverns at Kingston, Lake Ontario.
25. Mono Cavern.
26. Eramosa Cavern.
27. Cavern in the Bass Islands, L. Erie.
28. Subterranean passages in the Great Manitoulin Island, Lake Huron.
29. Murray's Cavern and subterranean river, Ottawa.
30. Probable caverns in Iron Island, Lake Nipissing.

The majority of those in the first class are on a level with the water, whilst the remainder are elevated above, varying from a few to upwards of sixty feet.

In the second class the level varies, but nearly all are above that of the sea, and, as will presently be described, none penetrate the

earth to a considerable depth; but this may be found to be otherwise as the explorations are continued. In none have animal remains been found, excepting in one instance, and they were discovered loose and not imbedded in stalagmite; and so far as I am aware, not a single object, such as a flint arrow-head or spear, used by the ancient inhabitants of the country, has been observed. This circumstance may in some measure detract from the value of the present communication; that part of the enquiry has still to be worked out, as many of the caverns have been but very partially explored, indeed some have scarcely been examined; and as several of them branch off by means of fissures and galleries, running from distinct chambers (most of the latter containing stalagmite), we may yet hope for interesting discoveries, particularly in that district of country in which exist the huge caverns of Mono and Eramosa in the Niagara limestone rocks of the Upper Silurian formation. The researches of my friend, Mr. Sterry Hunt, of the Canadian Geological Survey, have shown that these limestones are essentially dolomitic, and thus perhaps favourably constituted for the development of caverns.

1.—CAVERNS ON THE SHORES OF THE MAGDALEN ISLANDS.

On passing the interesting group of islands in the Gulf of St. Lawrence, known as the Magdalens, the observer is struck with their beautiful and picturesque appearance, which is suddenly presented to his view. The cliffs, which vary in height, present equally various colours, in which the shades of red predominate; these, contrasted with the yellow of the sand-bars, and the green pastures of the hill-sides, the darker green of the spruce trees, and the blue of sea and sky, produce an effect, as Captain Bayfield describes, extremely beautiful, and one which distinguishes these islands from anything else in the Gulf. Such an agreeable picture it has been my own good fortune to witness and admire. The striking feature in their formation is the dome-shaped hills rising in the centre of the group, and attaining a height of from two hundred to five hundred and eighty feet. They are composed of the Triassic or New Red Sandstone formation, which forms their base, being surmounted or topped by masses of trap rocks. The highest of the Magdalens is Entry Island, with an elevation of five hundred and eighty feet; its red cliffs rise at its north-east point to three hundred and fifty feet, and are what they have been described, truly magnificent and beautiful. The soft and friable character of the brick-red cliffs forming the shores of these islands, with their remarkable capes and headlands, have in many places yielded to the force of the waves, and have become worn into arches and caverns. This is most strikingly manifest at Bryon Island, which is nearly surrounded by perpendicular or overhanging cliffs, which are broken into holes and caverns, and fast giving way to the action of the waves. From the same cause are to be seen detached peninsular masses in a tottering state, which now and then assume grotesque forms. There is something peculiarly

interesting in this singular group of islands, lying so isolated about the centre of the great Gulf of St. Lawrence; and curiosity would be well repaid by a visit from one of the neighbouring ports. (See outline of Bryon Island, plate v.).

2.—CAVERNS AND ARCHED ROCKS AT PERCÉ, GASPE.

On the eastern coast of Gaspé, in the Gulf of St. Lawrence, there is a range of limestone cliffs, which commence on the southwest side of Mal Bay, at the perforated rock, called Ile Percé, and thence run in a north-north-west direction. Immediately south of these cliffs, which are six hundred and sixty-six feet in perpendicular height above the level of the sea, as described by Bayfield, are the Percé mountains, the highest of which, Mount Percé, is twelve hundred and thirty feet, and is visible forty miles out to sea.

The town of "Ile Percé," as it was called in Charlevoix's time, occupies the shores of Percé Bay, running from point Percé to White Head. This writer mentions in the second volume of his "*Histoire de la Nouvelle France*," p. 71, that Sir William Phipps, in his expedition against Quebec, landed at Ile Percé, in Sept., 1690, pillaged the town and robbed the church.

A reef connects the Percé Rock with Point Percé. This remarkable perforated rocky islet, which gives the name of Percé to this locality, is two hundred and ninety-nine feet in height, precipitous all round, and bold to seaward. This islet and the island of Bonaventure are considered outliers of the conglomerate rocks which enter into the formation of the main land at Percé, the former would seem especially to be a continuation of the range of cliffs on the south-west side of Mal Bay.* The Split Rock is an almost inaccessible mass of this strata, and stands up like a wall, in continuation of the limestone-cliffs of Barry Cape (Point Percé). It is five hundred yards long, one hundred broad, and is remarkable for the presence at its western half of two large holes or arches, through one of which a sloop at full sail can pass at high water. There is a lateral arch at the north-east side, scarcely perceptible from the water.

The perforations in this rock have been formed by the action of the waves of the sea, the same cause which has in the progress of time effected the disjunction of these outliers from one another and the main land. From the present position of the islet, which lies almost north and south, I am disposed to consider its northern aspect as the oldest, the two arched openings at that side forming what were once the entrance to deep caverns running into the rock

* Both islands are composed of the great mass of conglomerate, belonging to the lower carboniferous series, which here caps the Devonian rocks, and is made up of pebbles of all the rocks, from the old Laurentian of the north shore of the Gulf of St. Lawrence to the Devonian. — Professor Dawson's "*Week in Gaspé*." *Canad. Nat. and Geol.* Oct. 1858.

M A L B A Y

Cliff 666 ft high

PERFORATED ROCK

Pine Mountains
1274 feet
1750 ft in 1865

Supposed outline of the
land 300 ft high 1865

PERCE BAY

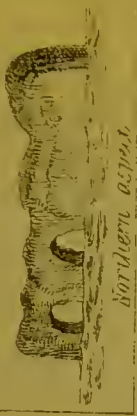
Pine Point

PERCE AND PERCE BAY



The Perforated Rock

LE PERCE



Northern aspect



PERCE BAY

southwards, which in the course probably of ages has been washed away by aqueous denudation. This view is strengthened by an examination of the intervening shores as they exist at present, which are portrayed in the diagram (plate vi.). It will be perceived that the coast line of Ile Percé runs along to Bonaventure Island, with an imaginary position of the land at one time between the south-west part of the latter island and the shore at the Bay of Percé, at the point where the cliffs commence at its southern third. This gives the southern coast a semicircular course, with a low shelving beach corresponding to that which now exists at Percé Bay on the one side, and the western coast of Bonaventure on the other; whilst the northern coast is rocky and precipitous, probably pierced with many caverns, and gradually diminishing in height to the southward.

3.—GOTHIC ARCHED RECESSES AT GASPE BAY.

The south-western shore of Gaspé Bay—from Point Peter to Douglass Town, a distance of twelve miles—consists of a succession of precipitous headlands, which in some places are two hundred feet above the sea. Going southward from Seal Cove, a part of the cliffs is composed of greenish-grey or drab-coloured pebbly sandstone, with many beds of conglomerate. In these beds dark red shale-balls exist, which yield to the weather and the beating of the sea, and leave large holes in the cliffs. The conglomerate beds, which belong to the Portage and Chemung groups of the Devonian or old red sandstone formation, are described as harder and more resistant to these influences and the irregularity in the wear of the rock, of which the dip is at an angle of sixty degrees, produces recesses and arches, giving the precipice the appearance of a piece of Gothic architecture.* From Point Peter the land rises in undulations to the chain of mountains, which lie about five miles inland. They attain to an elevation of fifteen hundred feet, and sweeping round Mal Bay, terminate with the Percé mountains, previously mentioned.

4.—THE “OLD WOMAN,” AT CAPE GASPE.

If a line is drawn in a north-north-east direction across Gaspé Bay from Seal Cove, it will touch a remarkable headland, or finger-shaped promontory of Gaspé limestone, called Cape Gaspé, which is the termination of a magnificent range of cliffs, six hundred and ninety-two feet above the sea. Close to the south-east extremity of the Cape was the “Old Woman,” or Flower Pot Rock, sometimes called “Ship’s Head” by the fishermen, and formed in a similar manner to the Flower Pot Rocks of the Mingan Islands. It was a truly remarkable object, and described by Captain Bayfield as being worn so small at its base by the waves, that it appeared astonishing

* Geol. Survey of Canada. Report of Progress for 1844.

that it could resist their force or the pressure of the ice. It subsequently disappeared, and has fallen into deep water, its base having become worn away by the action of the sea; but for a long time it formed a prominent object to the mariner. Boats could pass between it and the Cape when there was no surf. The Gaspé limestone of the Cape is the equivalent of the Niagara limestone of the upper Silurian formation. (See map, plate v).

5.—LITTLE RIVER CAVERNS, BAY OF CHALEUR.

From Cape D'Espoir to Little River, in the Bay of Chaleur, the cliffs which form the coasts are composed of beds of conglomerate, which belong to the lower carboniferous rocks already mentioned, with a gentle dip to the southward. They have been described by Sir Wm. Logan as very narrow, and consisting of nothing more than mere patches of the rim of the formation. These have been saved from the wearing action of the sea, which has carried off other parts, by the presence of harder tilted strata at high-water mark. This is well seen at the present time, for wherever the cliff is wholly formed of the rough conglomerate, deep horizontal caverns have been formed beneath by the action of the waves dashing against their base. The cliff being thus deprived of support, great masses, cracked vertically off, fall in huge fragments, which form a temporary talus, of which Sir William believes that it is possible the ice of winter may assist other causes in effecting a removal.*

6.—ARCHED AND FLOWER POT ROCKS OF THE MINGAN ISLANDS.

The Mingan Islands are twenty-nine in number and uninhabited, they lie close to the northern shore of the Gulf of St. Lawrence, are bold and precipitous on the north, east, and west sides, whilst they are low and shelving towards the south. None of them exceed three hundred feet in height, and ancient beaches and terraces are met with in nearly all, far above the reach of the highest tides. The present appearances of these islands are such as to indicate that at one time probably hundreds of caverns existed at the base of the cliffs and precipices of the Lower Silurian limestone rocks which were exposed to the wearing action of the sea. The violent action of the waves must have been nearly as great at one time as at present subsists on the shores of the Shetland Islands, where huge caverns are worn out of the hardest and most ancient rocks, which at the same time offer a greater resistance than the soft limestones which compose the Lower Silurian formation. The evidence of former sea-caverns in the Mingans consists of many hundreds of columns of various shapes and heights resembling flower-pots, and arched and perforated rocks. Although frequently seen by mariners and others,

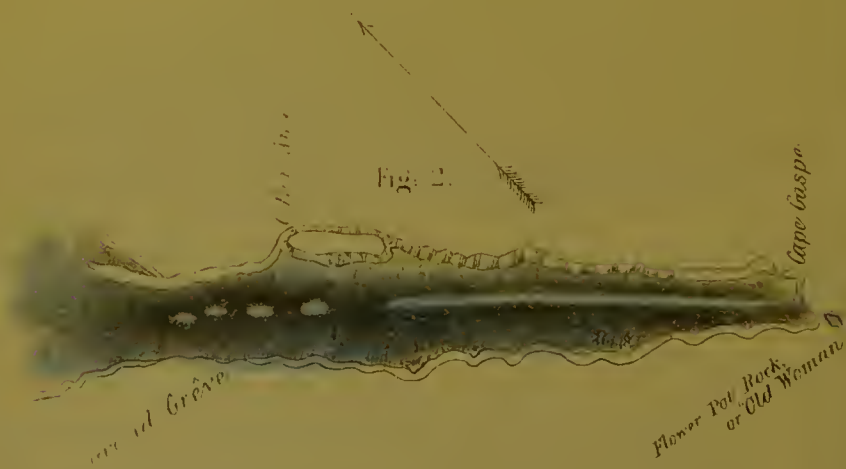
* Geol. Survey of Canada. Report for 1844.



LAKE OF THE OLD
WOMAN



Fig. 1



LAKE OF THE OLD WOMAN

CAPE GASPE

the only account published of them is in a paper by Captain (now Rear-Admiral) Bayfield, in the fifth volume of the Transactions of the Geological Society, second series, wherein a plate is given of a number of natural columns on the east coast of Niapisea Island.

These curious columns are met with in most of the islands far above the reach of the highest tides, running along the ancient raised beaches. A picturesque group is found on the west side of Large Island, a mile to the northward of its south-west point. Here hundreds of flower-pot and arched rocks stand up out of the rising tide to heights varying from ten to fifteen feet on the flat limestone, with breadths from a few feet to thirty or forty, widening at the top. Many, again, are above high water mark; and many straggling flower-pots are seen high up in the island, and with the succession of raised terraces strikingly illustrate the relative levels of the sea and land, when from fifty to sixty feet different to what they are at present.* A remarkable flower-pot rock is to be seen on the south-west point of the Outer Birch Island.

According to Admiral Bayfield, most of them vary in height from fifteen to thirty feet; some even exceed forty feet above the plateau of rock on which they stand. They are frequently arranged in lines upon terraces of limestone, precisely similar to those which are at present forming out of cliffs that are washed by the waves. This is especially the case at the eastern end of Niapisea Island, where the largest and most remarkable group of these rocks is to be seen.

It seems to me that there cannot be any doubt as to the manner in which these curious natural objects have been formed, namely, from the effect of the waves at different levels, as we see the same process going on at the present day. Great or small holes are broken by the sea into the limestone cliffs; these become larger and larger, spreading in various directions, when the roof of the cavern gives way, and leaves one or several pillars with a small base to support a partially arched top. The angular irregularities of the upper part of the pillar become worn away by the action of the sea and of the elements, as the land slowly rises, and we have what certainly resemble flower-pots, towers and incomplete arches situated high up above the influence of the tides, and formed as it were of horizontal layers of limestone piled one above the other.

A section of Large Island was found by Mr. Richardson, of the Canadian Geological Survey, to be composed of limestones of the Chazy, Bird's-eye, and Black-river formations, exceedingly favourable to the wear of the sea into arches and perforations. Most of the other islands are formed in the same strata, tho most northerly, however—Harbour Island, consisting of the Calciferous sand rock, which lies immediately above the Potsdam sandstone; whilst the main land is composed of gneiss belonging to the Laurentian system.

* Geol. Survey of Canada. Report for 1856.

7.—PILLAR SANDSTONES, NORTH COAST OF GASPE.

There is a small fishing station below St. Anne, on the North West Coast of Gaspé in the River St. Lawrence, which is called Tourette, from the occurrence of two pillars in the rocks of the coast formed by the action of the sea. The deposits in this vicinity consist of sandstones associated with bands of red and black argillaceous slates which belong to the Silurian group of the Middle Silurian formation. From atmospheric influences, the rock as described by Sir Wm. Logan* becomes fretted and pitted by deep holes or cells of various sizes and shapes, with thin but well marked divisions between them. The stone is soft, and appears to wear fast; and when the strata are vertical, or nearly so, the action of the sea between high and low water marks cuts them into pillars thirty feet in height, and four or five across, which, being sometimes smaller at the base than the summit, produce a very picturesque effect in the surrounding landscape. These pillar sandstones, as they are called, occupy the greater part of the coast between Cape Chat and the small settlement of Little Matan, where they disappear. Mr. Murray mentions† that they are displayed in considerable thickness near Little Metis, and occupy the coast as far as the Great Metis River, when red and green shales appear, which occupy the coast as far as Rimouski. This rock has the same tendency to wear away into pillar like shapes, when the strata are highly inclined, and the same kind of cellular fretted surfaces are observed to occur here as at Turettes and Cape Chat. Somewhat similar natural objects are seen on the south shore of New Brunswick, on proceeding from Dipper Harbour towards St. John, in the form of deep chasms and hollows, often separated from each other by large grotesque columns. The carboniferous limestone rocks here being of unequal hardness, yield to the sea at one point, and resist it at others; hence the rudest figures and the most unsightly pinnacles are placed according to the taste of the most disordered imagination.

8.—NIAGARA CAVERNS.

Of the four spots in the immediate vicinity of the Niagara Falls which receive the name of caves, but one only is present on Canadian territory, situated a mile and a half below the falls, half way between Clifton House and the suspension bridge. It was at one time called the Devil's Hole, but is now known as Bender's Cave, and is a natural excavation in the finely granular magnesian limestone, full of geodes lined with pearl spar, which here belongs to the Niagara limestone formation, hence sometimes called geodiferous limestone. A ledge of rock, twelve feet below the summit of the

* Geol. Survey of Canada, Report for 1844.

† Geol. Survey of Canada, Report for 1845-6.

precipice forms the floor of the cave, which is entered by a large mouth, is six feet high and twenty feet square; the roof is uneven and covered with damp mould.

There is another cave in the same formation on the opposite, or American side of the gorge, about sixty rods above the ferry, very difficult of access from the steep and precipitous nature of the banks. It goes by the name of Catlin's cave, is fifteen feet wide and ten high, and contains specimens of silicified moss. Neither of these caves are looked upon as objects of interest, their formation I conceive to have taken place at the time when the banks in which they exist were overflowed by the falls.

The appellation of the Devil's Hole is now given to a notch or indentation, said to be a hundred and eighty-five feet deep, half a mile below the whirlpool, on the right or eastern side of the Niagara river. It lays but a few feet from the main road, and can be looked into from above; it cuts through the Niagara limestone and shale, and Medina sandstone. This has been magnified into a great chasm surmounted by projecting cliffs of rock, but it is not strictly entitled to the name of a cavern.

There is a great hollow at the foot of the rock, between Goat and Luna Islands, formed by the disintegrating action of the water on the soft Niagara shale forming this part of the precipice, the crumbling fragments of which have been washed away, leaving the true Niagara limestone rock arching overhead fully thirty feet beyond the base, in a similar manner to Table Rock, and its continuation under the falls, which thus permits of visitors passing behind the great sheet of falling water in both places. This great hollow, known as Cave of the Winds, whose base is a hundred and thirty feet from the projecting ledge above, is a hundred feet wide. Those who have visited this interesting spot will, in common with myself, no doubt remember the sheet of falling water in front, forming a transparent curtain, dashing the spray with considerable force over every part of the cave, and the appearance of one or more arcs of a rainbow when the sun is shining upon it. The noise and turmoil of the place, the concussion of the atmosphere, and the general disturbance around, have appropriately given rise to the name which this cavern enjoys.

9.—FLOWER POT ISLAND, LAKE HURON.

The Isle of Coves is situated to the north of Cape Hurd, which is the extreme point of the peninsula of the Indian Reserves in Lake Huron. To the east of this island, is Flower Pot Island, which is chiefly remarkable for the presence of a number of insulated columns resembling flower pots, consisting of large tabular masses placed horizontally one above the other, being broad at the summit and narrow below. The largest of these is forty-seven feet high, and resembles a jelly-glass, being worn small near its base, and enlarging symmetrically towards the top. Many of them stand on a floor of

rock (composed of the Niagara limestone), which projects into the lake from the lofty island which bears their name. On other parts of the coast the rock is still wearing away by the action of the waves into the same remarkable pillar-like shapes. Those which at present exist have been formed in a similar manner to the Flower Pots on the Mingan Islands, and the "Old Woman" of Gaspé, having at one time constituted caverns, as I have already described.

10.—PERFORATIONS AND CAVERNS OF MICHILIMACINAC ISLAND, LAKE HURON.

The Island of Michilimacinac is situated near the straits of the same name, at the north-western part of Lake Huron, and is composed of gypsiferous limestone and rocks belonging to the Onondaga salt group of the American geologists. It is a hundred and fifty feet in height, and its precipitous cliffs are broken into a number of shallow and deep caverns by the action of the waves. One of these perforates a projecting point of rock near its south-east angle, and the general appearance of the coast is not dissimilar to that of the Pictured Rocks, presently to be described, only that they are not on such an extensive and grand scale. Besides these caverns, produced by aqueous agency, three objects of natural curiosity are visited by strangers in this island—they are the Giant's Arch, the Natural Pyramid, or the Sugar Loaf Rock, and the Skull Rock. The last of these is noted for the presence of a cavern, which would appear at one time to have been a place of ancient Indian sepulture, as numbers of human bones were discovered within it, and are even now observed lying about its mouth. The entrance to the cavern is low and narrow, but its dimensions are not very considerable. It possesses some historical interest for Canadians, from the fact that it was in this cavern that Alex. Henry was secreted by a friendly Indian after the massacre of the British garrison at Old Michilimacinac, in 1763.*

11.—THE PICTURED ROCKS, LAKE SUPERIOR.

These are included in the present paper, although in the territory of the United States, because they were celebrated among the French Voyageurs, who gave them the name of *Les Portailles*. The Pictured Rocks (as they are now best known) continue for twelve miles along the south coast of Lake Superior, about eighty miles west of White Fish Point. They consist of a series of lofty cliffs, varying in height, but mostly of three hundred feet, and are composed of horizontal stratified layers of grey sandstone, weathering of different tints, which are the equivalent of the Potsdam sandstone, a white quartz rock, probably overlaid here in some places by the calciferous sandstone. All along this coast the fury of the waves,

* See Henry's Travels and Adventures.

increased by every north wind, has produced a wearing action upon the base of the cliffs, scooping out arches and caverns, with over-hanging precipices, towering walls, diversified by waterfalls, numerous bays and indentations. Among the five great lakes, there is no spot so sublimely picturesque as the Pictured Rocks, which have been eloquently noticed by Schoolcraft. For miles all these wonderful natural effects are seen by the traveller, their characters constantly varying as the destructive elements at work throw down the overhanging strata in terrible ruins by the cavernous destruction of their base. At a distance these rocks are said to resemble dilapidated battlements and desolate towers. In many places the cliffs are nearly separated from the main land by extensive fissures, or they are almost solely supported by rude pillars, which form the divisions between numerous caverns, extensive enough to allow of boats to sail through them. At the Doric Rock, near the commencement of the pillared precipices, a vast entablature rests on two immense rude pillars, which formed the boundaries of one or more caverns. The action of the waves has completely excavated the rock of La Portail, which permits at this point a series of heavy strata of sandstone to rest solely on a single pillar standing in the lake, and is slowly becoming disintegrated by the same destructive action.

Schoolcraft thus describes his admiration of the Pictured Rocks: "All that we read of the natural physiognomy of the Hebrides, of Staffa, the Doreholm, and the romantic isles of the Sicilian coast, is forcibly recalled on viewing this scene; and it may be doubted whether, in the whole range of American scenery, there is to be found such an interesting assemblage of grand, picturesque, and pleasing objects."

12.—SAINT IGNATIUS CAVERNS, LAKE SUPERIOR.

The sandstone precipices of the island of St. Ignatius are described as not running down to the water's edge. On some of the islands, however, to the eastward, these cliffs reach the water, with fretted, crumbling fronts, and the parts accessible to the waves are often scooped into small caverns, supported on low arches like those in Grand Island, on the south shores of Lake Superior, but on a much smaller scale.*

13.—PILASTERS OF MAMMELLES, LAKE SUPERIOR.

There is a singular rock, named La Grange, upon the south end of a low island, sixteen miles S.W., from Grand Point, which rises at once perpendicularly for about ninety feet, rent at the top into rude battlements, and marked along its mural sides by deep pilasters

* Geography and Geology of Lake Superior, by Dr. Bigsby, Tran. Geol. Soc ser. 2, vol. i.

It is a conspicuous object for a great distance, and resembles a tower in ruins.*

14.—THUNDER MOUNTAIN AND PATE ISLAND PILASTERS, LAKE SUPERIOR.

Thunder Mountain, several miles long, rises from the eastern angle of Thunder Bay, and is fourteen hundred feet high as measured by Count Adriani. The west half of its summit is almost tabular; whilst the eastern half is irregular and hummocky, dipping suddenly in round masses, into a lower but still elevated country. About the middle of the south side, where the height is greatest, an immense cavity, with steep woody acclivities, is scooped out of the body of the mountain. The upper third of the elevation in the south-west is occupied by precipices, fissured into vertical pilasters, weathering orange red, and occasionally advancing in the form of large buttresses. These precipices are very extensive. The pilasters are smooth prolonged perpendicular slabs, formed by the disappearance of vertical slips of rock, at certain intervals.†

The tower-like eminence, fourteen hundred feet in perpendicular height at the west end of Paté Island, some miles distant, is flat-topped, and its sides are faced with vertical pilasters resting on a talus, like those of the Thunder Mountain. These pilasters have been compared to basaltic columns in the distance, with an apparent but not real horizontal stratification. "In some places they have fallen out, leaving hollows like flues in the sides of the cliff. In other places single columns stand out alone, like chimneys; in others again, huge flat tables of rock have scaled off from the face of the wall."‡ Trappose greenstone is the prevailing rock from Thunder Mountain westward, and gives rise to the pilastered precipices of Fort William.

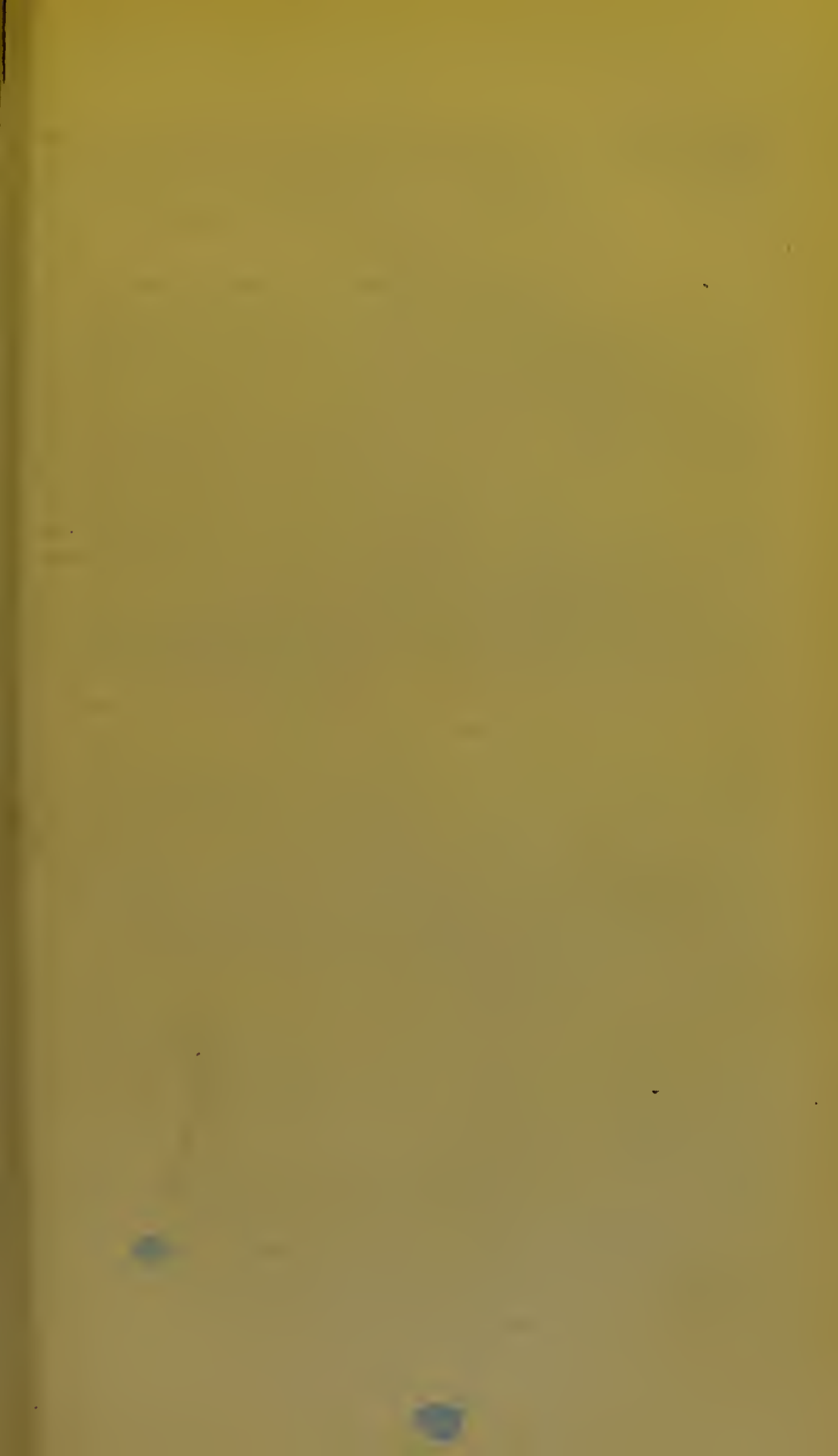
All the foregoing (Nos. 12, 13, and 14) are formed by the rocks belonging to the Huronian system of Sir William Logan, which consist of slates, sandstones, limestones, and conglomerates, with immense masses of greenstone interstratified. These repose unconformably upon the Laurentian rocks. The Grange is composed of greenstone, as well as many of the low islands of the Mammelles and others, which have become hollowed by the waves into bowls, caves, and small arches. Many of the rude colonnades are formed of porphyry, which plunge into the lake, or crown the highest summits, and occasionally they are fissured. The pallisades of Thunder Mountain are a greenstone trap.

In describing the geological structure of Maimanse, the most eastern promontory on the shores of Lake Superior, Dr. Dawson, of

* Geography and Geology of Lake Superior, by Dr. Bigsby, Tran. Geol. Soc., ser. 2, vol. i.

† Idem.

‡ Agassiz, Lake Superior, p. 93.





Montreal, mentions that the shore for some distance is excavated into many small caverns and ravines by the waves acting on the tufa and mineral veins. Some of these excavations are stated to be at a higher level than that of the waters of the Lake at the present time.*

15.—THE STEINHAEUER CAVERN.

The mountains of Torngarsuit, or the Evil Spirit, which are situated in latitude sixty degrees immediately south of Cape Chudleigh, the extreme northern point of the eastern coast of Labrador, have been described as rugged, barren, and black, and containing a huge cavern which the Eskimos declare to be the habitation of the devil. The only reference to this cavern which has come under my notice is that by the Rev. Mr. Steinhauer, whose notes on the geology of the Labrador coast are published in the second volume of the Transactions of the Geological Society (p. 488). However little is known about it in relation to its extent and the formation in which it exists, which is most probably Laurentian, from the description of the rocks on the east coast of Labrador, it seems appropriate to call it after the name of him who first drew attention to it. This cavern is most likely developed in the crystalline limestone belonging to the Laurentian rocks.

16.—THE BASALTIC CAVERNS OF HENLEY ISLAND.

On the southern coast of Labrador, in the Gulf of St. Lawrence, is Chateau Bay, recognised from a vessel in the offing by the high land in the rear of it, and more especially by the two wall-sided and flat-topped hills, composed of basaltic columns, which cap the summit of Castle and Henley islands, two hundred feet above the sea. They somewhat resemble fortifications in the distance, and present a picturesque appearance when approached nearer; they shelter to the south and east Henley, Antelope, and Pitt's harbours, whilst Whale Island and York Point do so to the westward. Admiral Bayfield describes the two last named harbours as perfectly secure, and fit for the largest ships.

The geological formation of all the rocks and islands of the coast of Labrador belong to the Laurentian system of Sir William Logan, and are the most ancient yet known on the continent of America. They extend from the north side of the Saint Lawrence from Labrador to Lake Superior, and occupy by far the larger share of Canada. They consist of gneiss, with interstratified bands of crystalline limestone, associated with layers of micaceous and hornblende schists and quartzite. The rocks of this part of the coast vary in colour from red to grey, and were formerly described as granite.

* Canadian Naturalist and Geologist, vol. ii., p. 4.

Castle Island is composed of gneiss, in which is found a mixture of a dark purplish grey felspar, fusible green hornblende and grey quartz, as observed by Capt. Campbell in 1827; the gneiss is capped by over-lying amorphous basalt fifty feet thick, nine hundred and ninety feet long, and two hundred and ten feet wide in its broadest part, which is near the centre. This mass of basalt is supported by an aggregation of basaltic columns, of which some reach to the height of twenty-five feet. They possess the usual characters, are vertical, in close contact, varying in size and the number of their sides, and are jointed. Capt. Campbell has determined their base to be a hundred and eighty feet, with their summits two hundred and fifty-five above the water. This is fifty feet more than is mentioned by Bayfield; but, as the columnar and amorphous basalt have perpendicular sides, its thickness was made out by a plummet to be seventy-five feet, the feature of most importance in relation to the caverns.

The summit is flat, and covered with moss and turf; its shape is oblong, and the columns pass all around it, and thus explains their fortification-like appearance on entering Henley Harbour. The island itself resembles a fish in shape, with a broad head, and having a distinct tail, which forms Chateau Point. It is a little over a mile and a quarter long, and a third of a mile broad at its northern part. (See map, plate vii.).

Henley Island is situated to the north-east of Castle Island, from which it is separated by a narrow channel leading into Henley Harbour, about a hundred and twenty yards wide, which is called by the fishermen Castle Reef Tickle. The shape of this island is that of a triangle, its most important side fronting towards the sea, and running due north and south; its southern side is hollowed out into two bays, which leaves the south-western part of the island in the form of a hill, two hundred and four feet high, capped by the basalt as in Castle Island, and possessing all the characteristics peculiar to that island, with its pillars of the same substance. The extent of the basalt is about a fourth of that of the sister island, the width of this part of the island containing it being about two hundred and seventy-five yards. On that side only towards the sea (east) are the columns visible; but as three caverns are there present, it was looked upon by Lieutenant Baddeley, R.E., as strong presumptive evidence that these basaltic columns traversed the mountain, a supposition which it appears to me to amount to a certainty, on comparing the two islands with one another. In these caverns (which must at one time have been Fingal's Caves in miniature) the columns possess the same regularity and juxtaposition as they do on the outside. The largest was found by Captain Campbell to be twenty yards deep by fifteen yards in the middle; the floors were strewn with the fragments of columns, and the sides were ornamented by those which their removal exposed to view; the ceiling was as smooth as that of a room, but of an almost iron blackness. The thickness of the amorphous basalt above was estimated at from thirty to forty feet, its course on both islands is from



east to west, the columns to the westward are of larger dimensions than those to the eastward.*

The north-west side of Henley Island is bounded by Antelope Harbour, which is between it and the main land; whilst south of it lies the singularly-shaped Stage Island, which is low, and forms the western boundary of Henley Harbour. Within the entrance of Chateau Bay is Whale Island, which again lies in the entrance of Temple Bay. The basaltic columns of Henley and Castle Islands can be seen from the east point of Wreck Bay, two miles and a-half to the south-westward, and I think at one time they must have been united with a continuation of the basalt from one island to the other. (See map, plate vii.)

The only other part of British America where basaltic rocks are met with on a grand scale is on the shores of the Bay of Fundy. The northern side of the large island of Grand Manan, three to four hundred feet high, twelve miles south of Campo Bello, New Brunswick, at the entrance of the bay, is perfectly basaltic in many places, and resembles large pieces of squared timber placed upright side by side, with a perfection and beauty equal to the basaltic columns of Staffa. Whole façades of columns have been broken off and carried away by the sea.† Near the Old Bishop the basaltic columns stand erect, and apparently support the precipice, having five and six faces. A small uninhabited island at the entrance of the Magaguadavic, is covered with basaltic pillars of from five to nine sides, many of them retreating into the sea. The celebrated cliffs of Cape Blomidon, in Nova Scotia, four hundred feet high, are composed of new red sandstone surmounted by crystalline basaltic trap, having a rude columnar structure, and presenting a perpendicular wall along the top of the precipice. For a general description of these cliffs the reader is referred to Dawson's *Acadian Geology*.

17.—EMPTY BASALTIC DYKES OF MECATTINA. (See Map, pl. viii.).

Among the most singular peculiarities of the southern coast of Labrador, is the occurrence of empty basaltic dykes traversing Great Mecattina Island in a north-east and south-west direction from one side to the other, as described by Admiral Bayfield.‡ This island, composed of the Laurentian rocks, is about three and a-half miles long, north and south, about three miles wide, and is five hundred feet high at its centre; it is through these granitic (?) hills that the empty dykes run. These remarkable dykes, with the position of the islands, in relation to the high land inside of Cape Mecat-

* Trans. Lit. and His. Soc. of Quebec, vol. i. In Lieutenant Baddeloy's paper, Castle Reef Rock is the name given to Castle Island, and Henley Island is erroneously called Saddle Island. There is a Saddle Island in Red Bay, some miles to the westward of York Point.

† Geol. Survey of New Brunswick. By Abraham Gesner, St. John, 1839.

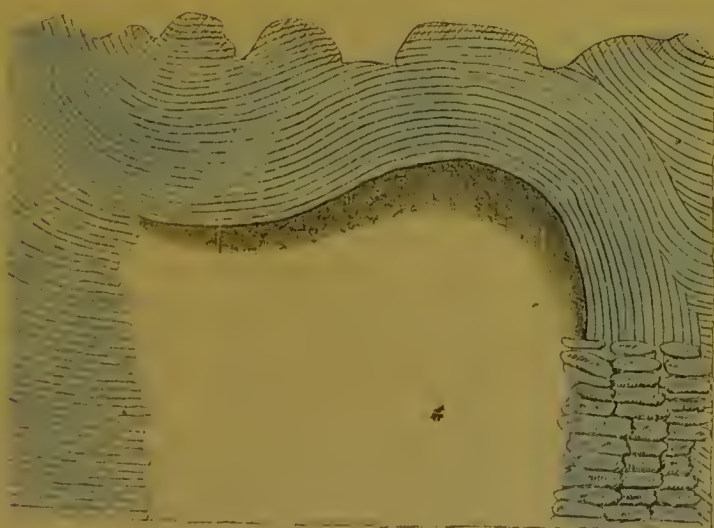
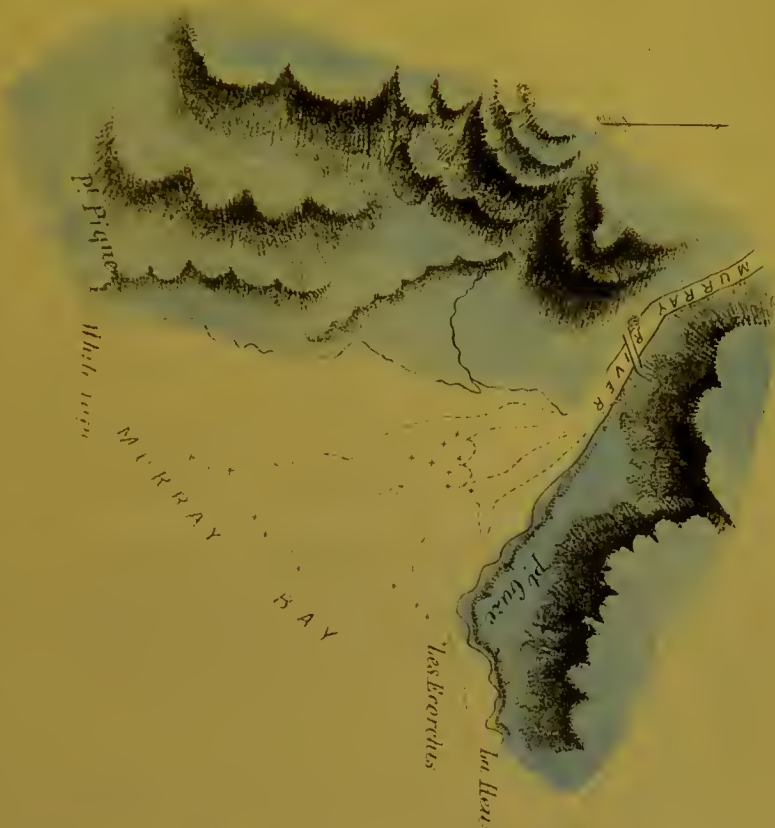
‡ Sailing directions of the Gulf and River St. Lawrence.

tina, which is four or five miles distant to the west north-west, are said to distinguish it from any other land in the Gulf of St. Lawrence. The nearest part of the mainland, Red Point, is rather more than two miles distant. Portage Bay, which is on the east of Cape Meeattina—a long and singular promontory of the mainland—runs to the northward a mile and a quarter between steep and high hills, fissured in the same manner as Great Island, with a rapid river at its head. The high land of Meeattina is seven hundred feet above the sea, and stands directly in rear of the harbour of the same name. It is not exceeded in height by any other land between Bradore and the Mingan Islands. Its granite is traversed from south-west to north-east by the same enormous basaltic dykes as are found on the Great Island. “They cut completely through the promontory into Portage Bay, ascending again on the eastern side of the latter, till they are lost to view beyond the summits of the hills. In Dyke Island several of them are empty as low down as the surface of the sea, dividing the island by immense open fissures in such a way as to distinguish it from all others in the neighbourhood.”

What strikes the mind with wonder in examining these dykes is that the basalt should have become crumbled and worn away from decomposition in such a manner as to leave them quite empty, thus resembling more the character of fissures produced by an earthquake. That they are true basaltic dykes, however, is proved by finding the remains of basalt in some of them, and by examining the neighbouring land, which is comparatively free from them, unless in the places described. For if they were not these, we might expect to see numerous rents and fissures over a less limited area than they occupy. Similar phenomena are seen in many parts of Scotland, but in a minor degree. The empty dykes of Meeattina are probably the most extensive known, and I imagine assumed their present condition when the land was submerged.

18.—BIGSBY'S CAVERN, MURRAY BAY.

On the northern bank of the St. Lawrence, ninety miles below Quebec, and six and a-half miles west by south from Cape Eagle, is the remarkable inlet known as Murray Bay, which is a mile and a-half wide, and nearly the same distance in depth. At its head is the rapid and unnavigable Murray River, which rises far in the interior, and flows down through a beautiful valley from several small lakes situated among the hills. At low water the bay is nearly dry, but there is anchorage for vessels close under the high rocky shore, a little to the eastward of the bay, as mentioned by Bayfield. The western point of the bay, from eight hundred to one thousand feet high, is Point Pique, or White Cape, in which is situated Bigsby's Cavern; its eastern point is Point Gaze, or Les Ecorchis, and a little further on is La Heu; the bay is directly opposite to Cape Diable,



FIGBY'S CAVERN

on the south shore, which is here ten and a-half miles across. (See sketch, plate ix.).

The prevailing rocks around Murray Bay belong to the Laurentian formation, their gneissic character being distinctly displayed in a set of beds on the west side of the bay above White Cape, marked by diversities of colour allied to red, green, black, and white; these beds are described as granitic, but very quartzose, with some bands among them possessing the aspect of a slightly micaceous quartz rock. Among the beds is a large grained red granitic dyke, running in general with their strike, which is north-west, at an angle of from thirty to thirty-five degrees. On the east side of the bay, near Les Écorchis, the gneiss presents the aspect of a dark grey compact slightly micaceous hornblende slate. It is here also cut by a very coarse-grained dyke, running generally with the stratification, and consisting of quartz and opaque white felspar, while hornblende prevails on each side of the dyke towards its contact with the gneiss. Still further to the eastward, before reaching La Heu, there is a very great white dyke of a similar character. No interstratified bands of crystalline limestone belonging to the Laurentian formation are here met with. The Potsdam sandstone, or white quartz rock, appears above White Point, and at two spots at the east side of the bay. At White Cape the calciferous sand rock is next observed; it composes the point which bounds the boat cove on the south. The beds here are about twenty-three yards broad, with a thickness of fifty-eight feet, and the rock is described as a calcareous sandstone, possessing arenaceous layers interstratified with occasional bands of limestone; the last forms the uppermost bed, as well as a few at the bottom. In some of the arenaceous beds translucent milky quartz-pebbles exist as large as hens' eggs, thus constituting them into conglomerates; but the grains are generally of such small size as to give an oolitic appearance to the rock: they consist both of limestone and quartz.* Dr. Bigsby found some of the nodules as large as a child's head. To the west of the boat cove are two hummocks of the rock, forming the bluff from which White Cape takes its name.

The conglomerate which thus composes the chief part of the precipice of White Cape is described by Dr. Bigsby as in strata more than a foot thick, abutting against mica slate in various unconformable positions.—“At the west end the layers are very thin, and are placed vertically, with a south-west direction, in some degree of parallelism to the contiguous mica slate. Near this they are contorted, until gradually towards the centre of the range they become horizontal. Here a singular disposition of the upper laminae is observed. They roof a shallow cave in undulating lines, which descend gently from above, and after curving upwards for a short distance, decline suddenly on the horizontal strata which constitute the lower half of the sides of the cave.”† (See sketch, plate ix.).

* Geol. Survey of Canada. Report for 1849-50.

† Amer. Jour. of Science, vol. v., p. 212. 1822.

This cavern was also examined by Lieut. Baddeley, in 1828, who describes* the sides and roof as coated in many places with a white incrustation, having none of the crystalline aspect of stalactite, being softer, and more resembling analogous appearances on the roofs of old brick or stone arches. It descends very rapidly for a few yards, when it suddenly narrows to a mere crack, admitting the passage of a boy or small person into a more spacious cavern, which had not been explored.

Bigsby's Cave has been known for some years, and has been noticed in some of the Canadian newspapers as, I believe, the Grotto of St. Paul; this is on the testimony of the Rev. Jos. M. Bellenger. None of these accounts could I lay my hands on; and as the first notice of the cavern was from the pen of Dr. Bigsby, it seemed to me quite proper that it should be called after him. It is not at all improbable that it has been further explored, through the able assistance of Dr. Fraser, of Murray Bay, and a more extended account published of its interior; in the present, however, especial pains have been taken to describe the nature of the rocks which exist in its vicinity. In Murray Bay and on the coast below, the Trenton limestone presents upwards of six miles to the St. Lawrence, and runs as many up the Murray Bay River, with a general breadth of two miles.

Dr. Bigsby found a brown or black splintery slate often interposed between the conglomerate and the dark limestone, which was plentiful at the cave. The curvature of the strata at the cavern at the west angle of Murray Bay and of the east shore of the Bay are objects of interest, and furnish "an additional evidence showing the temporary flexibility of rocks after consolidation, and their disturbance while in that condition." At the mouth of the grand river St. Anne, twenty-four miles below Quebec, Dr. Bigsby noticed three strong seams of grauwacke form as many concentric arches in the face of a naked and perpendicular bank, the outer of which is about eight feet high, and twenty-two feet span, the surrounding shale observing the same position; and at the bridge of the river Jacques Cartier, thirty miles above Quebec, there is a beautiful natural arch of blue limestone of similar dimensions.

There are very few places in Canada to be compared to Murray Bay for the beauty of its scenery and the surrounding features of geological interest. Here can be seen an instructive assemblage of the most ancient rocks, and an abundance of their characteristic fossils, among which are fine examples of *Orthoceratites*, to repay the zealous investigator. Slight shocks of earthquake are not unfrequent in this neighbourhood, and it is related that they occur nine or ten times annually.

19.—BOUCHETTE'S CAVERN, KILDARE.

This cavern was visited and first described by Colonel Bouchette

* Tran. Lit. and His. Soc. of Quebec, vol. i.



(Surveyor-General of Canada) in the report of his official tour though the new settlements of the lower province in 1824. It is situated in the township of Kildare, about thirty-five miles due north of the city of Montreal, but the precise locality I have been unable to determine, although from the description it may be close to the village of the same name. The southern half of the township is traversed by a broad band of the Potsdam sandstone, in continuation of the same rock running in a north-east direction from the south-western part of the township of Rawdon. That part of Kildare north of this band is composed of gneiss of the Laurentian system, most probably interstratified with some bands of crystalline limestone, in which the cavern is developed.

It was about the year 1822 that two young Canadian peasants, whilst prosecuting their sport of hunting the wild cat, pursued two of their game, until entering an obscure hole a little above the bank of the river, they lost sight of them. The more enterprising of the two attempted to enter the aperture in the rock, at that time barely sufficient to admit of his crawling into it, but without success. Providing themselves with lights, a second attempt was more successful. for "not only did they secure their prey (of which they have preserved the skin to this day), but they discovered," says Colonel Bouchette, "another of the many phenomena of nature, a description of which cannot be uninteresting."

The following account is given in the Colonel's words:—

"I descended into the cavern by means of a trap-door, which has recently been placed at one of its angles for the facility and convenience of strangers desirous of visiting this singular spot, having as my guides two of the inhabitants of the neighbouring house, bearing lighted tapers. The height of the cave where we entered is five feet, from which angle branch off two caves, the lesser whereof is of the following dimensions:—

Length	25 feet.
Breadth varying from	$2\frac{1}{2}$ to 9 "
Height	5 "

It bears about a south-east course from the entrance.

The other has in length	70 feet.
Width from	7 to 8 "
Height, gradually increasing	5 to 13 "

"The increase in the loftiness of the cave originates from the declivity of the ground part, which, at the north-eastern extremity, is at least twenty-three feet from the surface. It forms nearly a right angle with the first, at its south-western end, and an angle scarcely obtuse at the other with another cave, whose

Length is.....	80 feet
Average width	6 "
Height	5 "

At the south-eastern extremo of this cava branches off another of inferior size and consequence, bearing about a due north course, as may be deduced from the angle it makes with the last described.

It is in length	20 feet
Width	5 "
Height	5 to 4 "

"At the outward angle formed by this cave with the preceding one, is to be seen a nearly circular aperture of about a foot and a half in diameter, which leads to a cavern yet unexplored, the extent whereof is not known with any certainty; but conjecture and supposition will have it to extend two arpents—an astonishing distance as a natural subterraneous passage. Summing the lengths of the several caves above-mentioned together, we have a total distance of a hundred and ninety-five feet of subterraneity in the solid rock, offering a beautiful roof of crystallized sulphurate of lime, carved as it were by the hand of art, and exhibiting at once the sublimity of nature, and the mastery of the all-powerful Architect of the universe." (See plan, plate x.).

From the foregoing description there would seem to be five different caverns or galleries, and probably many more, if the fifth has been since explored. Three of them branch off from the entrance in different directions, whilst the remaining two do so at the termination of the central gallery. The roof throughout is covered with stalactites, but as no mention is made of stalagmite, nor of the presence of bones, we are left to conclude that they were absent, although the chances were much in favour of finding the latter, in consequence of there being a free and unobstructed entrance into the cavern.

20.—GIBB'S CAVERN, MONTREAL.*

This cavern, which is of humble pretensions as to size, is situated in the Island of Montreal, and no account of it had appeared before the one which I published in the "Canadian Naturalist and Geologist" for June, 1858. My attention was first drawn to it by my friend Dr. Robert Nelson, formerly of Montreal, and now of New York.

The cave exists on the border of a limestone ridge, running in a north-east and south-west direction, which skirts a number of farms back of the main road at Côte St. Michel. Its dimensions are twenty-five yards or more in depth, with a width of two or more yards. The latter varies a good deal and is somewhat irregular, but the roof is considerably wider than the floor, which is covered with water to the depth of some feet. A part of the floor will permit of a

* The association of my name with this cavern by a friend is my excuse for retaining it here.

footing, and when in the eave a person can stand upright, with plenty of room to spare. The roof is composed of limestone, and lined with a coating of stalactitical carbonate of lime, but from which there do not project any stalactites; some portions of the floor, however, contain stalagmites, a few specimens of which were collected. No bones of animals were found, possibly owing to the presence of the water. Their existence can only be ascertained by pumping the water out, which may overlies a sort of breccia. The ridge, which is composed of the Trenton limestone, here partakes somewhat of the character of a hill, at the base of which is an opening leading into the interior of the cavern. It was accidentally discovered some thirty years ago on the occasion of a party of *habitans* going out hunting. The dog belonging to the party commenced to scratch at the spot which forms the entrance, and suddenly disappeared; the animal had fallen into it, and his cries brought the hunters to the hole in the ground. The opening was enlarged, and the party entered by crawling on their hands and feet.

From the description of the cavern, it would appear that its origin is due to upheaval from below, producing a dislocation of the stratum of limestone and the formation of a wide fissure, which may be found ultimately to extend much further than the distance given in the foregoing account. The discovery of this cavern was looked upon at the time as something very wonderful.

21.—PROBABLE CAVERNS AT CHATHAM.

The greater part of the main road from Carillon to Grenville, a distance of thirteen miles on the northern banks of the Ottawa River, runs over the calciferous sand rock of the Lower Silurian formation. In many places the surface of the rock is exposed, and beyond the village of Chatham, towards Grenville, and even in Chatham, for a short distance the road consists of the solid limestone rock. As the surface of the rock is more or less rough or uneven, the road is an uncomfortable one to travel over in a wheeled vehicle. On driving over that part of the rock just near Chatham, a tremendous loud rumbling noise is occasioned by the stage, which is not heard in other situations. This has been attributed to the presence of one or more large caverns situated beneath the road at this place; and, on making enquiry on the spot, I learnt that a prevalent opinion has long been entertained by the country people and many intelligent persons in the neighbourhood, that a considerable cavern does exist in this part of the country in the place mentioned. On the many occasions that I have driven over this road the loud rumbling noise has been invariably observed by my fellow travellers as well as by myself. Some day an opening into the cavern may be discovered and the mystery solved. The main road is elevated and is probably from seventy to ninety feet above the Ottawa River.

22.—COLQUHOUN'S CAVERN, LANARK.

The locality of this cavern is in the northern corner of the township of Lanark, in the county of the same name, Western Canada, on the borders of the small river Mississippi, a branch of the Ottawa. A small branch of the former runs into this township from the neighbouring township of Ramsay, in a south westerly direction from the village of Bellamyville. The cave was discovered in the autumn of 1824, by Mr. Colquhoun, the owner of the ground, who, when clearing his land, came upon a hole at the foot of a tree, which was the first indication of its presence, and his curiosity induced him to descend and examine it. A notice of this discovery appeared in a Canadian newspaper, in November, which was seen by Dr. Bigsby, then in Philadelphia, who wrote to Lieut. Robe, of the Royal Staff corps at Montreal, upon the subject. That gentleman immediately visited the spot, examined the cave, in which were found a number of bones; and these, by favour of Dr. Wilson, of Perth, were all brought to Montreal.

The description of this cave is given by Dr. Bigsby in the *Amer. Jour. of Science* (vol. ix., June, 1825, p. 354) in two letters to the editor, dated Philadelphia, February and March, 1825. His information was derived from Lieut. Robe. The cavern is ten feet below the surface, with which it communicates by a sort of shaft or passage leading downwards, just large enough to admit the entrance of a man, being two feet three inches wide, by one foot nine inches broad. The cave is twenty-five feet long by fifteen broad, and is five feet high in the middle, gradually lowering at each end. At that part of it the most remote from the entrance, there is a fissure two feet by six inches, and therefore too small to permit of further penetration. The floor was covered with fragments of dark coloured granular limestone, of which the cave itself is formed; whilst the sides and roof were coated with small mammillary concretions of calc-spar. The entire township of Lanark consists of the Laurentian rocks, consisting of gneiss and interstratified bands of crystalline limestone, and I have no doubt whatever that it is in one of these bands that the cave is developed. If it has not been further investigated since its discovery, it might be worth while to enlarge the fissure at its extremity, particularly if it is found on examination to extend much further inwards.

A quantity of very large bones, in a state similar to that observed in grave yards, were found chiefly in a heap near, but not under, the aperture from above, many others were scattered among the debris of the floor. Lieut. Robe conjectured that the animal to which these remains belonged, must have been too large to have entered the cave alive or whole. As no mention was made whether the bones were encrusted with stalagmite, or formed a breccia, it is presumed such appearances did not exist. In June, 1859, Dr. Bigsby related to me that the bones were transmitted by Lieut. Robe to Dr. Buckland for examination and description; but although they were received, not

any published notice of them ever appeared. It is probable, however, that they were those of a deer, which Dr. Bigsby seems to think must have fallen in. If any remains of the antlers were among them when discovered, there could be no doubt of its being the animal supposed.

23.—QUARTZ CAVERN, LEEDS.

This cavity is perhaps hardly deserving of a place in this paper, but as it illustrates, to a certain extent, the formation of caverns by explosions in pyritous veins, it is not passed over, although its existence may now be quite forgotten. It is described in "A Sketch of the Topography and Geology of Lake Ontario," by Dr. Bigsby in the "Philosophical Magazine," for 1829. He describes a district thirteen miles west (south-west?) of Brockville on the high road to Montreal, which for three miles consists of white translucent quartz in steep and shapeless, often ruinous mounds, but still often betraying in its rents a south-west direction. It is of a fine granular, passing into a crystalline, texture. One of these eminences in the woods, half a mile north of the road, thirty to forty feet high, and near the easternmost of two creeks occurring here, has a vein of iron pyrites under the following circumstances. About the year 1811, a farmer was seeking for his cow in the woods, and when within a short distance from this spot, he was suddenly startled by a tremendous explosion, attended by volumes of smoke and sulphurous odours. On visiting the seat of disturbance he found the following appearances, which Dr. Bigsby thus describes:—"A rounded cavity twelve feet deep and as many long, but not quite so broad, with its sides consisting of very shattered quartz, spotted with brown oxide of iron, and profusely covered with a yellow and white efflorescence of sulphate of alumina, has its lower parts studded with masses of iron pyrites. The vein, which is visible for a yard and a half at the bottom, is described as eighteen inches thick, and disseminates itself into the surrounding quartz rock. This vein may be seen running east with a very high dip, to the distance of a yard and a half."

The Quartz cavern (if it may so be called) is ten miles west of Brockville, and situated in the township of Yonge, in the county of Leeds, and is within a couple of miles of the river St. Lawrence, and will therefore exist in the Laurentian formation, which is here closely approached by the Potsdam sandstone, a white quartz rock.

"Similar phenomena have been noticed in a mountain in Vermont (*vide* Amer. Journ. of Science for Feb. 1821), and in the country towards the head of the Missouri (*vide* Travels of Captains Lewis and Clarke)."

24.—PROBABLE CAVERNS, AT KINGSTON.

For the present, the existence of Caverns at Kingston is wholly conjectural. It has been assumed that because Hamilton's Cove on

its north shore is cavernous to a very great degree, that they may be discovered with animal remains in their interior. The limestone portion of Cedar Island is said to be equally cavernous, and Colonel Bonnycastle relates that there are some tokens of vast caverns under Point Henry, as a stream, which is of some volume in the spring of the year, loses itself suddenly there in a chasm.* The limestones of this locality belong to the Trenton formation, and are frequently cavernous.

25 AND 26.—MONO AND ERAMOSA CAVERNS.

The most extensive caverns which have hitherto been discovered in Canada, are found in massive and solid beds of bluish grey limestone (containing great numbers of encrinites) belonging to the Niagara group of rocks. The limestones of this formation constitute an elevated plateau at the Falls of Niagara, and running along the south-west border of Lake Ontario for a short distance, they form a terrace which continues in a north westerley direction to Cabot's Head in Lake Huron, and also of the Manitoulin Islands. Mr. Murray has shown that the rocks of this group here form two separate and distinct terraces, the lowest is the most decidedly marked escarpment, exposing strata below the cherty limestone bands which cap the precipices at Flamboro' West; whilst the upper, composed of the bituminous limestones and shales, rises more gradually in a succession of steps, terminating at the summit in a vast extent of table land.†

The crest of the lower escarpment is formed of the massive beds of encrinal limestone, passing below the cherty band just mentioned, and runs north from Flamboro' East, and they gradually increase in thickness as they advance to the northward. Thus, in the seventh concession of Nassagaweya, there is a vertical precipice of this encrinal limestone, from eighty to one hundred feet in height: and in the fourth concession of Eramosa, a branch of the river Speed runs between vertical and solid calcareous cliffs of sixty to eighty feet. In Caledon, the river Credit is flanked by similar cliffs one hundred feet high, which meet and form a crescent shaped precipice, after ascending the valley, over which the river is precipitated in a cascade; in the valley of the Nottawa, in Mono, the same character prevails. Similar cliffs were observed in the townships of Mulmer and Nottawasaga; and in the valley of the Beaver River, in Euphrasia and Artemisia, the same limestone is described as one hundred and twenty feet thick. If a line is drawn on the map almost due north from West Flamboro to Nottawasaga Bay, (the most southern boundary of the Georgian Bay), it will intersect the first six townships named, although they lay in four counties. The two last named townships lay a little further westward, and form the extreme western boundary of the county of Simcoe. A good view of the

* Tran. Lit. and His. Soc., Quebec, vol. i., p. 65.

† Geol. Survey of Canada. Report for 1850-51.

upper half of this interesting part of the country is given in a sketch of the valley of the Nottawasaga, by Mr. Sandford Fleming in the first volume of the first series of the "Canadian Journal," p. 223.

It is at the base of this limestone, the course of which has just been described, that a great series of huge caverns have been discovered, the roofs of which are studded with stalactites. The most extensive of those that were visited by Mr. Murray were what I shall for the present call the Mono and Eramosa caverns.

The *Mono Cavern* is situated on the twelfth lot of the second concession, east of the Hurontario Road, in the township of Mono, which forms the south-west angle of the county of Simcoe, on a branch of the Nottawasaga river.

The *Eramosa Cavern* occurs in the fourth lot of the fourth concession, in the township of Eramosa, county of Waterloo, on a branch of the river Speed, near Mr. Strange's mill. It extends under the cliff for between thirty and forty yards, and is about the same in width at its mouth; the roof from five to six feet in height at the entrance, slopes towards the floor inwards, and at the termination of the distance specified, the space becomes insufficient to permit of a man's body to pass, so that the extent of the cavern beyond is unknown; the roof and floor are studded with small stalactitical incrustations.

The account given of these two caverns is meagre enough, but several others are known to exist, although they are not described; their dimensions, however, are large, and it is probable that a distinct and important series of caverns pervade almost the whole of that part of the peninsula of western Canada, which is traversed by the Niagara limestones. It is highly important that the attention of scientific men in Canada should be directed to the subject of their discovery and investigation, at the same time making careful search for the bones of animals.

27.—CAVERNS IN THE BASS ISLANDS, LAKE ERIE.

The Bass Islands, two in number, lie some miles to the south-west of Point Pele island, at the western end of Lake Erie, and are formed of the superior group of the Helderberg series of rocks, which constitute the base of the Devonian system. In one of these islands is a cavern, which is entered by a round hole, a yard in diameter, gradually widening for fifty feet, when it opens into a circular space, one hundred feet in diameter, and seven feet high. The roof is studded with brown stalactites, frequently hollow, and seldom more than three-fourths of an inch thick, or longer than three inches. The floor is covered with stalagmite. This description was furnished to Dr. Bigsby when near this place in 1819, by Lieut. Dix, aide-de-camp to the American General Brown.* Dr. Bigsby was shown several conical stalactites from this cavern at Moy, opposite to De-

* Jour. of Science and Art, vol. iv. : 1828.

troit; they were ten inches long, by seven inches broad at their base. It seems to me not improbable that this cave was much higher at one time, and that the greater part of the roof consists of a great thickness of the stalaetitical carbonate of lime.

28.—SUBTERRANEAN PASSAGES IN THE GREAT MANITOULIN ISLAND, LAKE HURON.

This very large and beautiful island forming the northern boundary of Lake Huron, with a length of eighty, and average breadth of twenty miles, is well covered with streams and lakes. A series of bold escarpments run longitudinally through the whole length of the island, and are described by Mr. Murray* as varying from one hundred and fifty-five to three hundred and fifty feet in height above the level of the lake. At that part of the island near Manitowaning there is a lake of an hour-glass shape, possessing an area of fifty-five square miles (the whole area of the island is sixteen hundred square miles), associated with which there is a peculiarity, especially described by Mr. Murray. He found that this lake was one hundred and fifty-five feet above Lake Huron, and the "question of interest connected with this lake, which constitutes its peculiarity is the source whence it derives its supply of water." Mr. Murray found but one small stream to be its visible supply; and although thus receiving so scanty a tribute from the surrounding country, it furnishes water for three large brooks, which fall from it to the south, the west, and the north. These supply large lakes, ponds, and streams, among others, Tecumseth Lake, the level of the water in which was found in the early part of August to have been much higher than it must have been in the spring or some later period. This great island consist chiefly of the Niagara limestones; and as this is known frequently to give subterranean passage to streams, Mr. Murray thinks it probable that such a communication may exist between these lakes, and that there may be others in connection with them, and thus the water of Tecumseth Lake may arise from the drainage of a considerable part of the island.

It is possible that further investigation may develop some interesting facts in relation to these subterranean communications, and lead to the discovery of actual caverns. It is earnestly hoped that the labour of investigation may be undertaken by persons residing on the island.

29.—MURRAY'S CAVERN AND SUBTERRANEAN RIVER, OTTAWA, (See Map, pl. xi).

This very singular cavern exists at the fourth chute of the Bonne Chère river, one of the tributaries of the Ottawa river, recently explored by Mr. Murray, of the Canadian Geological Survey. At the

* Geological Survey of Canada Report for 1847-8.



chute a portion of the water turns abruptly off at right angles to the general course, running northerly for about ten chains through a great cavern formed in the Trenton limestone of the Lower Silurian formation. Mr. Murray describes the cavern as naturally nearly dry, except during freshets. Mr. C. Merriek, an enterprising proprietor of the cave and its vicinity, has caused a dam to be thrown across the main body of the stream, near the middle of the chute, which turns a sufficient quantity of water through to convert the channel into a mill-race, and the fall from the lower end is thus advantageously applied to drive the water-wheel of his mill.* The strata of limestone and shale exposed near Mr. Merriek's mill are in all forty-six feet thick, and well charged with fossils, of which Mr. Billings gives a list of sixteen Trenton, four Black river, one Birdseye, and two of the Chazy limestone species.† The fossils are very numerous at the mouth of the cavern and large flat exposure of strata above the bridge close by.

It is a source of considerable regret to me that a more extended account of this very interesting cavern has not been given, with a description of its interior, and where and how the stream disappears. From other sources I learn that the cavern is not only extensive, but likely to branch off in several directions.

30.—PROBABLE CAVERNS IN IRON ISLAND, LAKE NIPISSING.

Iron Island lays about midway between Duke's Point, one of the Indian settlements at the western extremity of the Great North Bay, and the French River, in Lake Nipissing, recently explored by Mr. Murray; it is composed principally of the Laurentian rocks; here and there, however, the crystalline limestones of this formation crop out, being frequently associated with iron ore. The beach near the outcrop is strewn with masses of all sizes, from great boulders weighing several hundred pounds to small rounded pebbles not larger than marbles. The limestone thus associated with the iron-ore is frequently cavernous, and the numerous crevices and smaller fissures are thickly lined with crystals of blue fluor-spar and red sulphate of barytes, or cocksecomb-spar. As the cavernous crystalline limestones are here interstratified with, and cut across by, trap, often assuming the concretionary character, it is probable some day that caverns may be discovered in the elevated cliffs of the island.‡

* Geological Survey of Canada, Report for 1853, p. 77.

† Geol. Survey of Canada, Report for 1857, p. 154.

‡ Geol. Survey of Canada, Report for 1855.

In the foregoing account it has been my aim and endeavour to describe the geological formations in which the caverns existed ; these will be seen at a glance in the following table :

1	Caverns on shores of Magdalen Islands	New Red Sandstone	
2	Caverns and arched rocks at Perte, Gaspé...	Lower Carboniferous	
5	Little River Caverns, Bay of Chaleur	" "	
3	Gothic arched recesses, Gaspé Bay	Portage and Che- mung groups	Old Red or Devonian
27	Cavern in Bass Island, Lake Erie	Helderberg series	
10	Perforations and Caverns of Michilimackinac	Onondaga Salt group	
4	The Old Woman, Cape Gaspé	Gaspé limestones	
8	Niagara Caverns	Niagara "	Upper Silurian
9	Flower Pot Island, Lake Huron	" "	
25	Mono Cavern	" "	
26	Eramosa Cavern	" "	
28	Subterranean Passages, Manitoulin Island ...	" "	
7	Pillar Sandstones, north coast of Gaspé	Sillery group	Middle Silurian
18	Bigsby's Cavern, Murray Bay	" "	
20	Gibb's Cavern, Montreal	Trenton limestone	
24	Probable Caverns at Kingston	" "	
29	Murray's Cavern and Subterranean River...	" "	
6	Arched and Flower Pot Rocks, Mingan	Chazy, Birdseye, and Black River lime- stones	Lower Silurian
21	Probable Caverns at Chatham	Calcareous sandstone	
11	The Pictured Rocks, Lake Superior	Potsdam sandstone	
12	St. Ignatius' Caverns, Lake Superior	Sandstone	
13	Pilasters of Mammelles, Lake Superior	Greenstone	Huronian Rocks
14	Thunder Mountain and Pie Island Pilasters, Lake Superior	Greenstone trap	
15	The Steinhaner Cavern, Labrador	Crystalline limestone	
16	Basaltic Caverns of Henley Island	Basalt	
17	Empty Basaltic Dykes of Meeattina	"	
19	Bouchette's Cavern, Kildare	Crystalline limestone	Laurentian Rocks
22	Colquhoun's Cavern, Lanark	" "	
23	Quartz Cavern, Leeds	Quartzite	
30	Probable Caverns, Iron Island, Lake Nipissing	Crystalline limestone	

Taking the two classes together as representing thirty distinct series of cavernous localities, one is found in the New Red Sandstone formation, two in the Carboniferous, two in the Devonian or Old Red, seven in the limestones of the Upper, two in those of the Middle, and six in those of the Lower Silurian formation, three in the Huronian rocks of Sir William Logan, and seven in the Laurentian rocks of the same geologist. In the last of these they are present in the interstratified bands of crystalline limestone, characteristic of this formation in Canada.

With a few exceptions nearly all occur in limestone rocks, and their origin has depended upon various causes. The first fourteen, which compose the first division, enumerated in a previous part of this paper, are the results of aqueous action, as their situation, present condition, and general description clearly prove. Perhaps an exception might be taken to the formation of pilasters and gothic arched recesses, which are more attributable to atmospheric influences. Volcanic agency has given origin to the basaltic dykes of Mecattina (17), the basalt of Henley Island (16), Bouchette's (19), and Gibb's (20) caverns. The same cause has most likely influenced the subterraneous passages of Manitoulin (28), and Murray's Cavern (29). On the other hand, Bigsby's Cavern (18), Colquhoun's (22), the Mono and Eramosa (25 and 26), and Bass Island's Caverns (27) were formed by some other agency, in which a slow disintegration of the rocks has occurred from chemical and other causes, and the soluble particles have been removed by the influence of water, entering by percolation from above, or between the neighbouring layers of rock. The origin of the Quartz Cavern, by the explosion of a pyritous vein (23), is clear enough.

It would be premature to enter at further length into the consideration of the formation of these caverns until further evidence has been obtained. It is hoped, however, that this first attempt to embody a descriptive and connected account of the caverns of Canada in a single paper will be productive of ultimate good results to science, by stimulating the zeal of those on the spot to carry out by further exploration an earnest investigation of this interesting subject, for there is still much to be done to render it complete. Many of the caverns are systematically noticed and described for the first time; and before this memoir was written, the inhabitants of that country were hardly aware that any caverns existed at all, except the comparatively few residing in the immediate neighbourhood of their presence.



